CIRCULAR No. 50
(New Horticultural Series).

PROVINCE OF BRITISH COLUMBIA.

DEPARTMENT OF AGRICULTURE
(HORTICULTURAL BRANCH).

POTATO-DISEASES.

FOR convenience we may classify potato-diseases into: (1) Diseases of the tuber; (2) diseases of the "vines."

TUBER-DISEASES.

Since these are of most direct importance, we will consider them first.

Common Scab.

This is found practically wherever potatoes are grown. It appears as round or oval, raised corky spots on the surface, or simply as a thick, irregular roughening of the skin. It may only form occasional small spots on the tubers, or it may almost cover the entire surface. Severe infestation often results in pits or cavities, which not only blemish and make much extra labour in preparing potatoes for the table, but also expose the interior of the tuber to various rot-fungi. Scabby potatoes are just as good for food, except that there may be more waste in preparing them, but are not desirable for seed purposes if the scab is at all severe.

Control.—Scab is due primarily to a bacterial organism or "germ," but there are also a number of factors which favour it. Control lies in disinfecting the seed and in avoiding the favouring causes, as follows:—

(1.) Do not use alkaline fertilizer— g., wood-ashes, lime, marl, etc. —with, or just before, the potato-crop. On the other hand, acid fertilizers, like acid phosphate, tend to reduce scab.

(2.) Do not plant the seed in contact with manure.

(3.) Avoid heavy, wet, undrained soil.

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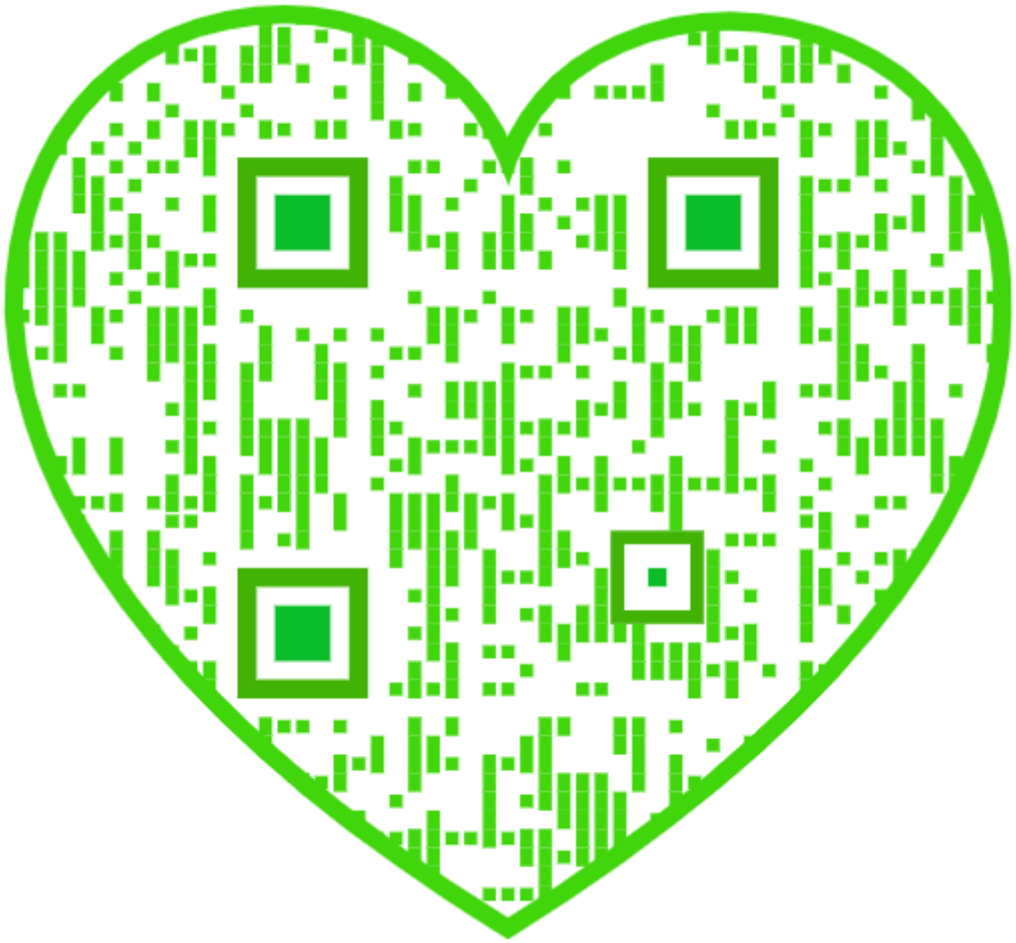

Powdery Scab.

This is found in many parts of the Coast and Island sections. It resembles common scab, but the spots are more even in shape, smaller, retain their individual outlines even when very numerous and close together, are covered when young with the smooth skin, and when mature are hollow and filled with brownish or greenish powder, whence the name. This is a somewhat more serious disease than common scab, as when severe it may go deeper into the substance of the potato and is more liable to cause "wilting" in storage.

Control.—Use sound seed, disinfect it, and avoid favouring causes as given above for common scab. Where it has gained a footing, rotation,

Tuber infected with the fungus of late blight. Note the discoloured areas under the skin, corresponding with the depressed discoloured areas visible on the surface.

Potato infected with *Fusarium* wilt. Note the discoloured vascular ring when a slice is cut off at the stem end.

disinfection of bins, cellars, and implements, and the avoidance of manure for the potato-crop from animals which have been fed infected raw potatoes, are all necessary.

Rhizoctonia.

Tubers are often seen with what appear to be small lumps of hard dirt adhering to them. It is found, however, that these are not readily rubbed off, and if moistened they turn black. If removed, however, the underlying skin of the tuber is found to be perfectly sound. These

black masses are composed of the resting mycelium of a fungus (*Rhizoctonia*), and in this stage do no injury. If planted with the tuber, however, the fungus develops and may produce considerable injury in the growing crop by attacking the base of the stems.

Control is difficult, since it is almost impossible to get a disinfectant strong enough to kill the fungus masses right through without injuring the potato. Tubers with large *Rhizoctonia* masses should be discarded for seed and the remainder disinfected. Corrosive sublimate is effective as a disinfectant for *Rhizoctonia*, while formaldehyde is not.

Silver Scurf.

This is due to a fungus which lives in the skin of the tuber. The attacked skin becomes more or less silvery and glistening, usually in spots, which, however, may run together until a large area of the potato is affected. The substance of the tuber is not affected, and the chief injury appears to be in increased wilting in storage.

Hand-selected seed free from the disease, disinfection to kill any loose spores, and rotation are the only measures known against it.

Late Blight.

This shows as leaden-coloured, often sunken spots on the surface of the tuber. On cutting, a brown discoloration will be found in the flesh corresponding to these and extending perhaps for a considerable distance within. The disease may spread rapidly through the tuber in storage if too moist and warm. Infection of the tuber takes place from the disease in the "vines."

Control of it, therefore, in the tuber is only attained by the control of it in the vines, which is fortunately possible. There are, however, certain precautions which can be taken to minimize infection of the tubers, even though the disease has been bad in the tops:—

(1.) Allow the vines to die down and dry out for a week or so before digging. This gives time for the death of many of the delicate spores, which are easily killed; or cut or pull the tops and remove them before digging.

(2.) Do not on any account cover piled tubers in the field with infected tops. If this is done with tops in which the disease is still active, every tuber may be infected.

(3.) Affected tubers should not be used for seed. Disinfection is of no use against this or other internal diseases.

Wilt or Stem-end Rot.

This shows as a ring of brown or blackish dots on cutting a thin slice off the stem end. The discoloration usually dies out farther down the tuber. Such tubers are liable to undergo a "dry-rot" in storage, whilst, if planted, the "vines" from them are liable to wilt

and die prematurely, as a result of the fungus spreading from the set up the sprouts.

A sample of potatoes showing a considerable percentage of this is better discarded for seed purposes. If no other seed is available, however, cut each tuber close to the stem end and throw out those infected. This can be done before disinfecting.

Fusarium Rots.

A number of fungi belonging to the genus *Fusarium* cause dry-rots. First infection takes place in the field, and the disease may gradually spread through the tuber, and from one tuber to another in storage. Control is difficult. Rotation, sound seed, and the careful sorting-out of all injured or diseased tubers before shipping or storing must be followed.

Soft-rots.

Soft-rots, which break down the substance of the potato to a soft, evil-smelling mass, are generally the work of bacteria which obtain entrance through mechanical injuries, or follow some of the above-mentioned fungi. They develop very rapidly under warm, moist conditions and furnish an additional reason for selecting only sound tubers for storage.

Non-parasitic Diseases.

These are certain troubles not apparently caused by parasites, but by physical conditions.

"Internal brown-streak" much resembles "wilt," but the brown dots are not arranged in so regular a ring, nor confined so much to the stem end.

"Internal brown-spot" appears as larger brown or blackish spots and blotches, one to many in number, scattered through the tuber. Both these appear to be due to soil conditions, possibly to overheating of the soil in hot weather.

"Second-growth" results in irregular-knobbed tubers, due to heavy rain or irrigation after growth has been checked by drought.

"Hollow-heart," or hollow-potato," is chiefly found in oversized tubers and is due to too rapid growth. "Black-heart," a black rubbery condition of the centre of the tuber, is due to lack of ventilation in storage, especially if accompanied by warmth.

DISEASES OF THE GROWING CROP.

Late Blight.

This is by far the most destructive potato-disease. It is, however, a disease of moist climates and does not occur in the Dry Belt in ordinary years.

It appears first on the leaves, usually not being noticed until late summer or fall. Brown, water-soaked spots appear, which gradually

extend. In warm, moist weather the disease may spread so rapidly that in two or three days an entire field looks as if hit by severe frost. A characteristic unpleasant smell accompanies this blighting of the vines. The premature killing of the tops checks the development of the tubers, thus reducing the yield. More serious still is the danger of the tuber becoming infected from the diseased tops, as previously stated, resulting in great loss.

The disease is controllable by spraying with Bordeaux mixture three times or more during the season. The first spraying may be given about the middle of July, and subsequent ones at intervals of two to three weeks, according to the amount of rain and consequent washing-off of the spray material.

It has been shown repeatedly that, even if no blight appears, spraying pays for itself in increased yield, the foliage being stimulated to greater and more extended activity.

Lime-sulphur, so much used for fruit-trees, is unsatisfactory for potatoes.

Early Blight.

This is so called because it usually first appears earlier in the season than late blight. It is a disease of hot, dry climates and seasons. It appears as dark-brown spots on the leaves, which, typically, have a very characteristic zoned or target-like appearance. The tips and margins of the leaf may also be affected. Tubers are not directly attacked, but if the leaves are seriously injured their development is checked. Spraying with Bordeaux mixture is effective against early blight, but must be done early, beginning when the plants are about 4 inches high.

Tip-burn.

The tips and edges of the leaves turn brown, curl up, and become crisp and brittle, due to too intense sunlight, especially after dull, cloudy weather. Often associated with early blight and controlled by the same means, the covering of Bordeaux mixture apparently screening out the rays of light most injurious to the plant-tissue.

Rhizoctonia.

The resting stage of this fungus on the tuber has already been described. During the growing season the fungus attacks the base of the stem near the level of the ground, forming dead brown spots which may completely girdle it. According to the severity of the attack, the vine either dies outright or the supply of food substances to develop tubers is prevented from reaching the underground parts from the leaves. In such a case the accumulation of food substances causes the production of small potatoes elsewhere. They may cluster round the base of the stem or be found above ground in the axils of the leaves—i.e., between the leaves and the stem.

There is no direct means of dealing with this disease. Rotation and the use of clean, disinfected seed are, however, of value. It appears, also, that strong vigorous vines can bear a good deal of injury from the fungus without showing serious results in the crop. Hence anything that favours a vigorous condition will help to prevent loss.

DISINFECTION OF SEED-POTATOES.

This is of use only against external diseases such as scab and powdery scab. It is useless against internal ones like late blight and wilt. Pick over the potatoes before treating, rejecting those visibly affected with rots, late blight, or badly attacked by scab.

Formaldehyde Treatment.

Formaldehyde is a gas. The commercial article (also called formalin) is a solution of this gas in water. In buying by measure, know what you are getting. The usual druggist's pint is the American or wine pint, weighing 16 oz. The imperial pint weighs 20 oz. Where large quantities are to be treated, it might pay to buy co-operatively through farmers' organizations. The present wholesale price is about $3 per gallon, imperial (about 10 lb.), in 40-gallon barrels, while the retail price is about 50 cents a pound. It has a powerful hardening and corrosive action on the skin, especially the stronger solutions, and the gas is irritating to the eyes, throat, and nose.

Effects of Treatment.

This destroys spores adhering to the surface of the tubers, but the result will last only as long as the tubers are kept protected against contamination. Formaldehyde, being a gas, evaporates, after which there is no further protection from it. Hence, if treated tubers are to be dried and stored instead of being planted at once, it is essential that the place of storage be also disinfected thoroughly by swabbing down with formaldehyde, 1 lb. to 10 gallons of water, or bluestone, 1 lb. to 10 gallons. A cement or board floor is preferable, and this should be similarly treated. If only an earth floor is available, it should be well swept, sprinkled with one of the above solutions, and then covered with sacks or canvas soaked for an hour in one of them, or two hours in the dipping solution. It would, however, in this case be better to treat just before planting and avoid drying and storing. It is then only necessary to spread the treated tubers on dipped sacks out-of-doors, and cut and plant as soon as the excess of liquid has drained away. If more potatoes are treated than actually planted they are not injured for human or stock food. Sprouted potatoes are liable to have the sprouts broken off and the remainder seriously damaged. Tubers intended for specially early yields must therefore be treated before putting into the sprouting-boxes, which should also be disinfected.

Dipping.

Add 1 lb. 40-per-cent. formaldehyde to 30 gallons of water. Put enough of this into a barrel or other vessel to completely immerse a sack of potatoes. With an ordinary 40-gallon barrel this will take about 25 gallons. The remainder can be put in some convenient container to make good the waste as each sack is dipped. Immerse a sack of potatoes, raising it up and lowering it a few times to hasten the penetration of the liquid, and leave for one and a half to two hours. Take out and spread them out to dry on the prepared floor. This method is, however, too slow if large amounts are to be treated. In this case immerse as before for fifteen to twenty minutes; then take out, put on the prepared floor or on some dipped sacks, and cover with other dipped sacks or canvas to keep in the gas, and leave until one and a half to two hours have elapsed since the first immersion. The sacks can be put out side by side in regular order and the time when the first is taken out noted. They can then be removed from the other end of the pile in the same order, dumped, and spread out to dry. In this way six to eight times as many tubers may be treated in the same time. After removing the sack from the immersion it may be stood for a few minutes in another tub to catch the excess of liquid which drains from it. At ordinary temperatures the liquid does not become appreciably weaker, and it is only necessary to add enough fresh solution to keep the liquid at the level required for full immersion. If more convenient for any reason, the tubers can, of course, be placed directly in the liquid, but as a rule they are much more conveniently handled in sacks. After the day's work is over put into the liquid the sacks, baskets, etc., to be used afterwards in handling the treated tubers, put on the lid of the barrel or cover over, and leave for two or three hours or overnight. Planters, wagons, etc., should all be disinfected, preferably with the stronger solution previously used for the floors, or the liquid left over from dipping may be used. In this case it would be well to wash them down twice.

In cutting potatoes, have two knives and a small dish of the formalin solution at least as strong as that for dipping. If a diseased tuber is cut, drop the knife into the dish and take out the other. This will avoid contaminating sound tubers from diseased ones.

Treatment with Corrosive Sublimate.

This is the most effective, and the only satisfactory one against *Rhizoctonia*. It has, however, the following drawbacks:—

(1.) Corrosive sublimate is a violent poison to human beings and animals if taken internally. It must therefore be used and disposed of with great care. After using, dig a hole where there is no danger of the liquid draining into surface channels, and pour it in.

(2.) It corrodes metals, including tools, knives, etc., itself becoming weakened.

(3.) The solution becomes weaker with each lot of potatoes treated. It is generally recommended to discard it after four lots of potatoes have been immersed. As the strength of solution used is 4 oz. to 25 imperial gallons, this makes the treatment expensive. (The price of corrosive sublimate in wholesale quantities is about $3 per lb.)

(4.) Treated potatoes cannot be used for human or stock food.

GENERAL RULES.

General rules for minimizing disease in the potato-crop:—

(1.) Do not grow potatoes too close together in the rotation.

(2.) Select seed, if possible, from a sound crop. In any case plant sound tubers only.

(3.) Disinfect to kill the germs of surface-borne diseases.

(4.) In moist climates spray with Bordeaux mixture, as required, during the growing season.

(5.) Sort potatoes carefully at digging-time, rejecting all injured or diseased ones for shipping or storing.

SEED-PLOT.

Where considerable areas of potatoes are grown, seed-disinfection with liquids becomes impracticable. In such a case disinfection with formaldehyde gas is necessary, which requires special provision. The best plan, however, is to set aside a plot large enough to grow the seed necessary for the main crop. The seed for this plot can be properly treated, and the crop, if carefully handled and stored to avoid infection, can then be planted without seed treatment at all.

This is the system which every potato-grower should adopt, as it is possible in this way not only to control disease better, but also to rogue out wrong varieties and unsatisfactory plants.

(For fuller details on the above diseases and the making of Bordeaux mixture, consult Bulletin No. 68.)

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This circular has been prepared by J. W. Eastham, B.Sc., Provincial Plant Pathologist, at the request of the Horticultural Branch.

Copies of this circular may be obtained free of charge on application to the Horticultural Branch, Department of Agriculture, Victoria, B.C., or from local branch offices of the Department.

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